AUTOMATIC VETERINARY MEDICAMENT DELIVERY SYSTEM

by

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BACKGROUND

This invention relates to veterinary delivery devices for delivering medicaments, including pharmaceuticals or vaccines, to a plurality of poultry or other animals. In particular, this invention relates to a portable, electrically powered veterinary delivery system for reliably providing a precise amount of pharmaceuticals, or vaccine, rapidly to a plurality of fowl, porcine, ovine or other animals.

Injection devices are known in the art. Numerous injection devices have been provided in prior art that are adapted to include a manually operated plunger. A hand-held syringe, having a barrel and manually operated plunger, has been used to administer vaccines, antibiotics and other biological products. A problem with this device and method is that the accuracy of the dose is dependent on the manual strength and attention of the operator. When injecting large numbers of birds or other animals, the operator's hands become fatigued resulting in inaccurate doses being delivered to the bird or other animal being injected. An additional problem has been accidental injury to the operator as a result of either movement of the bird or other animal during the injection process or lack of lighting present at the barn or other injection locale. Injection into a human of veterinary products can cause permanent injury that may even result in amputation. Identifying which birds or other animals have been injected within a flock or herd has also been a problem.

While these units may be suitable for the particular purpose which they address, they would not be as suitable for the purposes of the present invention as hereinafter described.

SUMMARY

The present invention is directed to an automatic veterinary medicament delivery system that

satisfies these needs for delivery of precise amounts of medicament to an individual animal or fowl. The medicament includes any fluid products for immunizing purposes or for treatment. The system provides rapid and consistent one-handed administration of the medicament, without fatigue-affected changes in the amount of medicament delivered, to large numbers of fowl, porcine, ovine, or other animals. An automatic veterinary medicament delivery system having features of the present invention comprises an electronic control unit having means for quickly adjusting the dosage of medicament to be delivered by injection. The veterinary delivery system includes several hand-held injection devices from which to choose, depending on desired use, each having a push-button trigger, at least one needle, a headlight, signal lights, optional dye marking means, and an optional mixing chamber for mixing medicaments at the time of delivery of the medicament, the hand-held injection devices being easily connected and disconnected by means of quick connect fluid couplers for being in fluid communication with the system and a nine-pin amp electrical connector for being in electronic communication with the control unit. One embodiment hand-held unit provides a single needle for injecting especially the ear of cattle. Another embodiment hand-held unit provides a single needle plus marking means. A third hand-held unit provides two needles for injecting two unmixed medicines simultaneously. A fourth hand-held unit provides a single needle, but the hand-held unit is inverted with a pistol grip attached for use especially with thick-skinned animals, such as cattle or pigs. All of these hand-held units provide means to deter self-injection of the user. In some hand-held units, this safety device is in the form of an emergency stop button. In the fourth hand-held unit, a safety interlock is provided that prevents injection until a retractable resilient member is forced to a second, retracted position , to complete an electrical circuit permitting injection to take place. In all of these delivery systems, a source of fluid medicament, tubing interconnecting the injection device and the medicament, an electrically powered pump in fluid communication with both the injection device and the medicament, actuation means for activating a pump forcing the medicament through the tubing from medicament source to the injection device for dispensing, are provided. A quick connect fluid coupler permits coupling of each hand-held unit to the pump. A nine-pin amp electrical connector connects the electrical power portion of each hand-held unit to the control unit. Also, a convenient carrying system is provided. Optional means for marking injected animals are also included. Methods for administering two medicaments simultaneously are also provided.

Manually depressing a trigger on the hand-held injection device of this delivery system, in conjunction with inserting a needle into the subject body, actuation of the pump causes fluid to flow through the hollow needle accomplishing an injection. An emergency stop button is provided if an error is made, e.x. the needle goes through the ear, or through the ear and into the user's hand. This is an important deterrent to self-injection. An additional embodiment provides a safety interlock member which must be depressed to the needle hub to close the electrical switch which in turn actuates the pump causing fluid flow through the hollow needle only when the needle is fully injected actuates an injection. This safety interlock is adjacent to the needle and positioned to extend to the length of the needle. This safety interlock is then depressed to the point adjacent to the needle hub as the needle is inserted. At this juncture, an internal extended rod from the safety interlock closes the electrical circuit by means of a Hall-effect switch. This, in turn, actuates the pump to cause fluid flow through the needle. This feature also deters accidental self-injection. Injection cannot take place until the needle is fully inserted, thus enabling the operator to withdraw an accidental stab prior to injection taking place. The goal of both of the systems is operator safety. Self-injection is a very serious accident among vaccinating crews.

The delivery system includes a means of marking, by automatically pressing an applicator pad containing a pre-measured amount of dye pumped into it, in order to prominently and automatically mark each treated animal adjacent to the injection site.

The delivery system is powered by a compact, rechargeable 12-volt battery or 110 volt AC/12 volt DC converter for sustained operation reducing fatigue and the likelihood of repetitive stress injury to the operator.

The delivery system includes a self-priming peristaltic pump for delivery of a consistent amount of medicament. The pump also reverses to retrieve unused medicament upon completion of each injection chore. The use of a peristaltic pump permits the system to be valve-free.

The delivery system has an optional head lamp at the injection site for greater safety and accuracy of injection. The delivery system includes a green LCD on the handle to indicate that an injection is in progress. A red LCD on the handle indicates the medicament fluid is low.

The delivery system also includes an automatic counter to record and total the numbers of injections.

The delivery system also includes an optional mixing tube to combine medicaments.

The delivery system also includes a cleaning process to clean the tubing of the delivery system following each job. To accomplish cleaning, the pump switch on the face of the control unit is set to "forward" in order to circulate cleaning/sanitizing solutions for effective "clean in place".

The system is enclosed in a back-pack or box, which protects it from dirt and dust and also provides a convenient place to store and transport the component parts.

It is the general object of the present invention to provide a novel and improved multiple dose veterinary delivery system that provides a precise dosage to a plurality of animals without requiring frequent refilling of the system between administrations of medicament to a plurality of animals.

A further object is to provide a veterinary delivery system which can be manipulated with one hand freeing up the second hand of the user to hold onto the subject animal for injection.

It is a further object to provide a veterinary medicament delivery system which ensures administration of precise amount of a medicament to the animal.

It is a further object of the invention to provide a veterinary delivery system that uses a self-priming pump.

It is a further object of the invention to provide a veterinary delivery system that eliminates waste of medicament and that provides an accurate count of doses delivered.

Another object is to increase the safety features of such an injection system by reducing the hazard of self-inoculation of the operator. A further object is to provide an easily transportable injection system.

Other objects and advantages will become apparent from the following detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Understanding of the invention will be enhanced by referring to the accompanying drawings, in which like numbers refer to like parts in the several views and in which:

Fig. 1 is a plan view of the medicament delivery system of the current invention;

Fig. 2 is a perspective view of the first embodiment hand-held unit of the medicament

delivery system of **Fig. 1**;

Fig. 3 is a side view of a hand-held unit of the medicament delivery system of **Fig. 2**;

Fig. 4 is a side perspective view of a second embodiment hand-held unit of the medicament delivery system of **Fig.1**;

Fig. 5 is an end view of a third embodiment pistol grip hand-held unit;

Fig. 6 is a perspective view the control unit of the medicament delivery system of **Fig. 1**;

Fig. 7 is a perspective view of the interior of the control unit of **Fig. 6**;

Fig. 8 is a plan view of the second embodiment hand-held unit where two medicaments are pumped through two pumps simultaneously at the same rate;

Fig. 9 is a plan view of the second embodiment hand-held unit where two medicaments are pumped through two separate control units at differing rates;

Fig. 10 is a plan view of the medicament mixing tube;

Fig. 11 is a side view of the third embodiment pistol grip hand-held unit;

Fig. 12 is a plan view of the fourth embodiment hand-held unit where one medicament is injected and a dye pad applicator is present; and

Fig. 13 is a side view of the fifth embodiment, pivoting hand-held unit, with certain portions shown in cross-section.

DETAILED DESCRIPTION OF THE CURRENTLY PREFERRED EMBODIMENTS

Understanding of the invention will be further enhanced by referring to the following illustrative but non-limiting example.

The term "medicaments" is intended to include serum, vaccine, antibiotics, and any other fluid products that may be used for immunizing or for treating poultry, bovine, ovine, porcine or other animals.

OVERVIEW

Turning now to the drawings, in which like reference characters refer to corresponding elements throughout the several views, **Fig. 1** illustrates an electrically powered automatic veterinary medicament delivery system, shown generally at **20**. System **20** is housed in a container such as a

back pack and includes a hand-held unit **40** in fluid communication, by means of conduit tubing tubing **78**, with a medicament container **70**. A first embodiment hand-held unit **40,** single needle **56**, no dye means, is especially for use in injection of a medicament into the ear of a bovine. All of the hand-held units **40** have a generally cylindrical shape with a flattened surface **41** on which , *in* embodiments one through three, are mounted both a trigger **42** and an emergency stop **44** button. The fourth embodiment also has a trigger but no emergency stop. Also shown are a green LCD **48**, which lights to indicate an injection is in progress, and a red LCD **50** which lights to indicate that the medicament level is low. The "function" key pad **108** is touched on the control unit **110** to set the anticipated number of total count so that the low medicament bottle LCD lights up at the appropriate time, ex. when 90% of the doses have been given. Head lamp **46** is used to illuminate the area of injection, as well as an optional dye pad **172** along with the needle mount **58,** in actual use, a Luer lock, all mounted on a proximal surface **22** of the hand-held unit **40'''**. Entering this distal end **24** of hand-held unit **40'''** is tubing **82** containing medicament **84**, dye **86** and electrical power cords **88**. All of the various hand-held unit embodiments **40, 40', 40", & 40'''** look and work similarly. A pump **100**, which sits atop a control unit **110**, sucks up the medicament from within medicament container **70** through tubing **80** and forces the fluid medicament from pump **100** exiting through tubing **82** and continuing through conduit tubing **78** for delivery by the hand-held unit **40** through a hollow needle **56**. The control unit **110** utilizes an electronic dosage control **130**, shown in detail in **Fig.7,** to deliver a predetermined precise amount of medicament upon injection. Additionally, the electronic dosage control **130** provides means of changing the dosage of these predetermined precise amounts of medicament. Control unit **110** also provides optional marking means. Marking dye, in an optional embodiment shown at **Figs. 2,3,& 5**, is delivered through dye means, such as by an applicator pad **172,** simultaneously with injection of the medicament, marking the individual poultry, porcine, ovine or other animal injected. Control unit **110** function key pad **108** has an on/off control of dye means. Control unit **110** also provides for counting the number of injections made.

In all of the disclosed embodiments, fluid from more than one medicament container **70** can be injected simultaneously through their respective tubing **80**, the medicaments forced by the pump **100,** through an optional mixing tube **190**, shown in detail in **Fig. 10**, intermixing the two

medicaments prior to their being injected through the selected hand-held unit **40, 40', 40", 40"'.** Additionally, in all of the embodiments, fluid from more than one medicament container **70, 70'** can be injected simultaneously. Where different dosages are needed, two control units **110, 110'** with the associated pumps **100, 100'** can be connected up to a single hand-held unit **40, 40', 40" 40"'** for simultaneous injection, either after mixing the medicaments and injected through hand-held unit **40 40"** and **40"'**, or when the medicaments cannot be mixed for whatever reason, by injecting simultaneously through two needles through hand-held unit **40'** as shown in **Fig. 4**. Once the requirements are determined, which medicaments are to be injected, can they be mixed, if not, are they administered at the same dosage, the appropriate hand-held unit **40, 40', or 40"** is selected and electronically connected to control unit **110** by the Amp connector **94**, attached to the end of conduit tubing **78** and in fluid communication by means of a quick connect fluid connector **196** at the end of each tubing **82, 76,**. If the medicaments may be mixed, the mixing tube **190** must be attached to the tubing **82** by quick connect fluid couplers **196**. Quick connect fluid couplers **196** are also mounted on pump**100** to attach tubing **80** to medicament container **70** . If more than one pump is needed but the medicament to be administered can be given at the same dosage, then a two pump system **100, 100'**, such as shown in **Fig. 8**, is used. Either hand-held unit **40** or **40' or 40"'** may be used. When the medicament to be administered is not of the same dosage, and cannot be mixed, then two control units **110, 110'** must be used, such as shown in **Fig. 9,** then hand-held unit **40"** is selected and connected to both control units **110,110'** by means of conduit tubings **78, 78'**. A nine-pin amp connector **94** connects the electronic control unit **110** to any of the hand-held units **40**. A four-pin amp connector **122** connects the electronic control unit **110** to the dye pump. Another four-pin amp connector **124** connects the control unit **110** to the battery **126**. These different types of amp connectors protect against accidental connection of the wrong device to the outlet at the control unit **110.**

The control unit **110** sets the dosage, the injection count, the anticipated number of total count so that the low medicament bottle LCD lights up at the appropriate time, and optional marking dye by means of touching the display LCD for each function, by pushing the "Function" keypad **108** and using the up and down arrows **106** to select the appropriate choice, dose, injection count, low bottle warning and marking dye.

As shown in **Fig. 1**, the electrically powered automatic veterinary medicament delivery system is set for injecting ears of cattle. While the hereinafter described safety interlock could be added to this hand-held unit **40**, it is not felt to be necessary when injecting ears of cattle. The ears are injected, by the way, to prevent damage to an edible portion of the cattle.

The power source for running any embodiment of this system is a re-chargable battery although plugging into the circuitry of the barn or other housing could be used.

Fig. 2 is a side perspective view of second embodiment hand-held unit **40'** of the medicament delivery system **20,** having a single needle **56** and dye pad applicator **172**. In this view, hand-held unit **40'** has a generally cylindrical shape with a flattened dorsal surface **41** on which are mounted both a trigger **42** and an emergency stop **44** button. Also shown are a green LCD **48**, which lights to indicate an injection is in progress, and a red LCD **50** which lights to indicate that the medicament level is low. The "function" key pad is touched on the control unit **110** to set the anticipated number of total count so that the low medicament bottle LCD lights up at the appropriate time, ex. when 90% of the doses have been given. Head lamp **46** is used to illuminate the area of injection, as well as an optional dye pad **172** along with the needle mount **58,** in actual use, a Luer lock, all mounted on a proximal surface **22** of the hand-held unit **40'**. Entering this distal end **24** of hand-held unit **40'** is tubing **82** containing medicament **84**, dye **86** and electrical power cords **88**. This hand-held unit **40'** is especially for use in injection of a medicament into a bovine at a point other than the ear. Marking means conspicuously mark the animal as it is injected. Quick connect fluid couplers **196** are mounted on the terminal ends of both medicament tubing **82** and dye tubing **86** to permit quick, convenient connection of this particular hand-held unit **40"** to control unit **110**.

Fig. 3 is a side view of the hand-held unit **40'** of the medicament delivery system of **Fig. 2** showing an additional light **52** indicating that an injection is in progress.

Fig. 4 is a side perspective view of a third embodiment hand-held unit **40"** of the medicament delivery system of **Fig.1**. This embodiment has the same general shape as the first embodiment, namely hand-held unit **40"** having a generally cylindrical shaped body with a flattened dorsal surface **41** on which are mounted both a trigger **42** and an emergency stop **44** button. This embodiment adds a second needle **56'** and needle mount **58'** Luer lock to the proximal surface of the hand-held unit **40"**. Although the optional dye applicator pad is not shown, it will be understood that this dye

applicator pad is an option on all of the hand-held units. Also not shown in this view but understood to be mounted on the hand-held unit **40"** is an additional light indicating that an injection is in progress similarly to light **52** in **Fig. 3**. Two needles **56, 56'** are needed with this embodiment because two medicaments that may not be mixed are being injected, as indicated by the two medicament tubings **82, 82'** . Quick connect fluid coupleres **196** are mounted on the terminal ends of both medicament tubings **82, 82'** and dye tubing **86, 86'** to permit quick, convenient fluid connection of this hand-held unit **40"** to control unit **110**. If the dosage is the same for both medicaments, a second pump**100'** can be mounted atop the first pump **100**, as shown in **Fig. 8,** connected to a hand-held unit **40"**. The two pumps, **100, 100'** piggy backed atop the other, are interconnected by an drive shaft **134** whereby the pumps turn at the same rate of speed delivering identical amounts of medicament. If, however, different dosages of the two medicaments is needed, due to differences in viscosity or potency, or the like, two control units, **110, 110'** would be needed, as shown in **Fig. 9**. The tubing from both units would be combined so only one hand-held unit **40"** is needed. Although only one processing of the subject animal occurs, two injections of different un-mixed medicaments are given simultaneously to the same subject animal.

Fig. 5 is an end view of a fourth embodiment hand-held unit **40"'** which has a pistol grip **30**. In this embodiment, the generally cylindrically shaped hand-held unit **40"'** is basically turned upside down so that the flattened surface is on the ventral side. The trigger **42** is mounted on the front surface of the pistol grip **30** for convenience of the user. This embodiment has the same elements on the proximal surface **22**, namely a needle mount **58,** a hollow needle **56,** an optional dye means **170**, with associated dye tubing **86**, and headlight **46**. Added to this embodiment is safety interlock **150** which consists of a solid member **152**, which when forced by contact with the subject animal skin, from a first, extended position, to a second retracted position in alignment with the proximal surface **22**, releases the needle mount to allow injection to occur. The safety interlock **150** is designed to prevent accidental injection of the human user of the system. Accidental injection of certain veterinary products can cause severe injury of the area accidentally injected. Mounted on hand-held injection device **40"'** is solid member **152,** a solid member preferably of plastic, which in its first position, extends at least as far as the tip of needle **56**. Solid member **152** is urged to a second position, pushed to the tip of the needle hub 57, as indicated by arrow in **Fig.11**, when the needle **56**

and therefore the solid member **152** comes into contact with the body of the poultry or other animal. When solid member **152** is biased to the second position, it completes the electrical circuit and actuates the pump **100** which permits an injection to take place. This built-in safety device deters accidental, and severely injurious, self-injection. Needle **56** is replaceable. When needle guard solid member **152** reaches a second position, it actuates a Hall effect switch, internal of the hand-held injection device **40, 40', 40"** which controls administration. This Hall effect switch is wired in conjunction with the trigger **42** on the hand-held injection device **40"**, making it necessary for the trigger **42** to be depressed in order for the switch at the solid member **152** to work. This feature adds materially to the safety and reduced fatigue of the operator, as well as the speed of operation since the operator can depress the trigger **42** constantly allowing injection to occur automatically and as quickly as solid member **152** is depressed.

Trigger **42** is in electrical communication with pump **100**. In the fourth embodiment of hand-held injection device **40"'** trigger **42** must be depressed, and the needle **56** must be fully inserted, to complete the electrical circuit in the Hall effect switch which actuates the pump **100** and results in an injection. This hand-held injection device **40"'** has a safety interlock **152**. The other embodiments, **40, 40'& 40"** have an emergency stop button **44**, although a safety interlock **152** could be used on all embodiments. At this time, a safety interlock is not deemed necessary on hand-held injection device **40** because it is primarily used on the ears of cattle where the needle is parallel to the ear. A safety interlock would not have any animal body part to urge the interlock to it's second, retracted, position. Also at this time, a safety interlock is not deemed necessary on hand-held injection device **40'** because this embodiment is primarily used on soft-tissued animals such as poultry where again the safety interlock would not have a substantial body part to urge the interlock to it's second, retracted, position. A dye source is indicated at **60** with its associated tubing **86** which interconnects, again by a quick connect fluid coupler, to conduit tubing **78** that is in fluid communication with hand-held injection device **40"'**.

Fig. 6 is an external illustration of the control unit **110** of the medicament delivery system **20** of this invention with pump **100** mounted on top. In all embodiments, control unit provides electrical power to hand held units **40** as well as electronic information is set in electronic control to control dosage, dye on/off, and amount, injection count and low medicament level as well as the

automatic reverse feature following each injection. A nine-pin amp electrical connector **94** connects the electronic control unit **110** to any of the hand-held injection devices **40**. A four-pin amp electrical connector **122** connects the electronic control unit **110** to the dye pump. Another four-pin amp connector **124** connects the control unit **110** to the battery **126**. These different amp electrical connectors protect against accidental connection of the wrong device to the outlet at the control unit **110.** Display **112** is an LCD display which lights up to illustrate the different modes of the control unit **110**, namely, the amount of the selected dosage, the amount of dye used per subject animal, and the count of injections made. The dosage, which is controlled by setting the number of pulses that are emitted by the electronic photo optic sensor **138** to accurately inject the desired dose, depends on the viscosity and temperature of the medicament and must be calculated at each injection session. For example, very low viscosity liquid, such as water, requires 44 pulses per 1.0 milliliter (ml) while on the other hand, dosages of high-viscosity vaccines could require as many as 110 pulses per 1.0 milliliter (ml). The number of pulses in an injection is manually controlled by the up and down arrows **106** on the face of control unit **110**, can be set at each injection session. Whether or not to use dye and the amount of dye used can also be selected by control unit **110**. The amount of dye to be used can be set in 0.1 second increments. The injection count can be re-set to zero after each injection session by means of the up and down arrows **106**. Switches on the face of control unit **110** include an on-off power switch **114**, pump switch **116** that controls forward or reverse pump, and light switch **120** which controls power to the head lamp **46**.

Being able to switch the pump to reverse enables reclaiming of the sterile serum, or other medicament, that is in the tubing and in the hand-held injection device **40**, and pump **100** itself. Reversing the pump **100** at the end of each job, by switching upwardly switch **116**, effectively retrieves medicament in the system to the container **70** or to be discarded. This procedure can then be followed by switching the pump switch **116** to "forward" to 'clean-in-place' the system **20** by pumping hot detergent water followed by a rinse, or any cleaning procedure outlined by the user. In actual use conditions, an on/off switch such as model # SLP 130A4-16, made by Honeywell, Minneapolis, MN power switch has been used although other comparable power switches could be substituted without changing the invention.

Tubing **80** provides medicament to pump **100** while tubing **82** leads from the pump **100** to the

particular hand-held injection device **40** selected.

Fig. 7 is a perspective view of the interior of the control unit of **Fig. 6**. Electronic dosage control **130** uses a photo-optic unit to control the volume of medicament fluid pumped by pump **100**. Pump **100** drives shaft **134** which turns an encoder disc **132** that has slots that are placed at a calibrated distance from one another around the perimeter of circular encoder disc **132**. As the encoder disc **132** rotates in response to rotation of drive shaft **134**, the slots pass between an emitter and a receiver of a photo-optic sensor **138**. The encoder disc **132** passes through the sensor **138**. The sensor **138** "counts" the number of slots that pass between an emitter and receiver. The combination of the distance between the slots and the number of slots allowed to pass through the sensor **138** determines the amount of serum that is dispersed. This sensor **138** is wired into a circuit board **140** which includes a micro chip **142** which allows selection and control of the distance the fluid travels in pump **100**. This method is preferred because of the ease in changing doses and *in view* of the changing viscosities of the medicaments used. To change the dose, the user manipulates the function mode by pressing the "Function" key pad **108**, of control unit **110**. The current number of pulses will flash on the display **112**. The pulse count can then be changed by pressing the "UP" or "DOWN" key pad **106** until the correct number of pulses are shown. The press the "Function" keypad **108** to set the correct dose. The LCD display **112** will then stop flashing.

Counter also displayed on LCD display **112,** records a dispensed dosage every time any of the hand held units **40** is activated. If desired, the counter keeps a running total of the number of injections given while the veterinary medicament delivery system **20** is turned on. The counter is reset manually by using the down arrow **106**.. A micro switch liquid crystal display (LCD)unit, made by Curtis Instruments, Inc., 204 Kisco Ave., Mt. Kisco, NY 10549, has been used and works well although other LCD's could be used.

The dosage is set depending on the number of light pulses sensed by the photo optic sensor **138**. The user determines how many pulses are equal to 1.0 cc of the injectible medicament and calculates the desired dosage, then determines the number of pulses required for the correct dosage. This setting is reached by, first, pressing the "Function:" key pad **108**, at which time the current setting will flash in the LCD **112**. Then, by use of the "UP" or DOWN" keypads **106**move the number of pulses to the desired dosage setting at which time the "Function" key pad **108** should be

pressed to set the correct dose. The LCD **112** will then stop flashing. The appropriate dose is selected by using the LCD display **112** on control unit **110**.

Fig. 8 illustrates the third embodiment hand-held injection device **40"** used to simultaneously inject two medicaments of similar viscosities. Because these two medicaments may not be mixed, for whatever reason, they are run through separate pumps, **100 and 100'** which are interconnected by an extension of drive shaft **134,** shown in detail in **Fig. 7**. Tubing **82 & 82'** carries the pumped medicaments separately to hand-held injection device **40"** for simultaneous injection. **Fig. 9** illustrates the third embodiment hand-held injection device **40"** in the case of desiring to simultaneously inject two medicaments of different viscosities. Again, these two medicaments are not be to mixed, for whatever reason, and are run through two separate control units, **110 & 110'** before being run through tubing **78 & 78'** into hand-held injection device **40"**.

Fig. 10 is a side view of a medicament mixing tube **190** with quick connect fluid connectors **196** at either end. Y-shaped coupling **198** brings together the two medicaments to mixing tube **190**. This tubing is inserted in the tubing somewhere between the pump **100** and any of the hand-held injection devices **40, 40'**, or **40"'**. Injectible medicaments from two different sources may be mixed together by use of this mixing tube **190** prior to injection. This is used where the separate injectibles are compatible. In the case where they are not able to be mixed for some reason, the two injection hand-held injection device **40"** is used. In use, the mixing tube **190**, having a cylindrical barrel chamber **192** with a centrally positioned mixing member, double helix fins **194** shaped as two worm gears rotating in opposite directions, is provided enabling mixing together of two fluids for delivery to any of the hand-held injection devices **40, 40', 40" or 40"'**.

Optional marking means is provided in the form of an applicator pad **172** that marks dye onto the subject animal or fowl at the time of injection to conspicuously mark an individual within a group that has been injected.

Hand-held injection device

First hand-held injection device **40**, shown in detail in **Fig.1** has a one-piece generally cylindrical housing with a trigger **42** and an emergency stop button **44** mounted on the flattened dorsal surface **41**. A red LCD **50** indicates low medicament bottle level while green LCD **48**

indicates an injection is in progress. Both are also mounted on the dorsal surface **41**. An additional injection in progress LCD **52** is mounted on the distal surface **24** of the hand-held injection device **40,** as shown in **Fig. 3**. Head lamp **46** and dye applicator pad **172** are mounted on the proximal surface of hand-held injection device **40**. The needle mount **58**, in actual use a Luer lock, receives hollow needle **56.** Emergency stop button **44** provides means for preventing accidental injection. The medicament in tubing **84** travels from the pump**100** and is joined by dye in tubing **86** . Both are wound together with power cord **88** into a larger tubing **78** that is received by the distal surface **24** of hand-held injection device **40**. Dye applicator pad **172**, into which dye is pumped, extends from the hand-held injection device **40** and onto the animal to automatically mark the animal at each injection. Hand-held injection device **40** is especially useful in injection of thin-skinned areas, for example, the ears of cattle.

Hand -held unit **40'**, shown in **Figs. 2 & 3** , is similar in most respects to the first embodiment but adds a dye applicator pad **172**. Hand-held injection device **40"**, shown at **Fig. 4**, adds an additional hollow needle **56'** and needle mount **58'.** In this embodiment as illustrated in **Fig. 4**, has an addition second medicament tubing **82'** and power cord **88'** . Emergency stop button **44** provides means by which to deter accidental self-injection. The medicament in tubing **82** travels from the pump**100** and is joined by pumped medicament in tubing **82'** . Both are wound together with power cord **88** into a larger conduit tubing **78** that is received by the distal surface **24** of hand-held injection device **40"**. Hand-held injection device **40"** is especially useful in injection of poultry.

Hand -held unit **40"'**, **Fig. 5**, is similar in most respects to the first, second and third embodiments but the housing of hand-held injection device **40"'** is inverted and a pistol grip **30** with the trigger **42** mounted thereon, is added. A safety interlock **150**, with solid member **152**, is mounted on the proximal surface **22**, is used as means for preventing accidental self-injection. The medicament in tubing **82** travels from the pump**100** and is joined by dye in tubing **86** . Both are wound together with power cord **88** into a larger conduit tubing **78** that is received by the distal surface **24** of hand-held injection device **40"'**. Dye applicator pad **172**, into which dye is pumped, extends from the hand-held injection device **40"'** and onto the animal to automatically mark each animal at each injection. Hand-held injection device **40"'** is especially useful in

injection of thick skinned animals such as pigs, sheep and cattle in places other than the ear.

Hand -held unit **40""**, **Fig. 13**, is similar in most respects to the first, second, third and fourth embodiments but the housing of hand-held injection device **40""** is a two piece housing with a head portion **32** and a handle portion **34** connected by pivot **36** with the trigger **42** mounted on the handle portion **34.** A safety interlock, with solid member **152**, is mounted adjacent the hollow needle **56** and is used as means for deterring accidental self-injection. The safety interlock with solid member **152** has a spring **38** to urge the safety interlock solid member **152** into a first position, extending at least as far as the needle **56**. Safety interlock with solid member **152** is urged to a second position, pushed to the tip of needle hub **58** as indicated by arrows in **Fig. 13**, when the needle **56** comes into contact with the body of the poultry or other animal. When safety interlock solid member **152** is biased to the second position, it completes an electrical circuit, a Hall effect switch **31,** and actuates the pump **100.** The medicament in tubing **82** travels from the pump**100** and is joined by dye in tubing **86** . Both are wound together with power cord **88** into a larger conduit tubing **78** that is received by the distal surface **24** of hand-held injection device **40""**. Dye applicator pad **172**, into which dye is pumped, extends from the hand-held injection device **40""** and onto the animal to automatically mark each animal at each injection. The pivot **36** permits re-positioning of the handle portion **34** relative to the head portion **32** to enable the user to more comfortably fit the injection device **40""** to his or her hand for prolonged use and to facilitate different types of injections as when changing between injecting swine and poultry.

All hand -held units **40, 40', 40", 40"' 40""** are equipped with a hollow needle **56** which is in fluid communication, through injection set tubing **82**, with the liquid medicament container **70**. When the needle **56** is inserted, the medicament fluid is injected.

In all of the hand-held injection devices 4**0,40', 40", 40"', & 40""**, electrical wiring is connected to port on the control unit **110** by a durable, water resistant electrical amp connectors **94,122,124**, such an electrical connector is made by Time Electronic Supply Co., 7803 Green Bay Rd. Suite 302, Bloomington, MN 55439. A nine-pin amp connector **94** connects the electronic control unit **110** to the hand-held injection device **40**. A four-pin amp connector **122** connects the electronic control unit **110** to the dye pump. Another four-pin amp connector **124** connects the

control unit **110** to the battery **126**. These different amp connectors protect against accidental connection of the wrong device to the outlet at the control unit **110.** A quick connect fluid coupler **196**, such as that made by Coulder Products Co., 1001 Westgate Dr. St. Paul, MN 55114, connects the injection set tubing **80, 82** to pump **100** and also to mixing tube **190**. The quick connect fluid couplers **196** enable the user to select the hand-held injection device **40, 40', 40" ,40"' or 40""** needed and also to disconnect the tubing when replacement is needed. The quick connect fluid couplers **196** also permits the hand-held injection devices **40, 40', 40", 40"' or 40""** to be disconnected for ease of transportation and storage. Additionally, the quick connect fluid couplers **196** are water proof to a submersible depth of three feet. This connector seals tightly and will prevent dirt and grime from entering the electric contacts that they are protecting.

All hand-held injection devices **40, 40', 40" , 40"' & 40""** are also equipped with a light emitting diode as an illuminating head lamp **46**, mounted adjacent to the needle **56**. A diode such as model HLMP-1503, made by Gilway manufacturer has been used and works well although other light emitting sources could also be used. Head lamp **46**, is in electrical communication with battery **126**, **Fig.1**, provides illumination in low light areas, such as barns, and further attracts attention to the needle **56** to prevent accidental self-injection by user. Poultry are vaccinated in low light in order to keep the birds calm.

Several indicator lights are located on all hand-held injection devices **40, 40', 40", 40"' & 40""**. Low serum bottle level is indicated by red LCD signal light **50** set to the count and will light when the bottle is down to approximately 10% of capacity, e.g. in a 250ml bottle, signal light **50** lights when the bottle is down to about 25. A green LCD **48** mounted on hand-held injection devices **40, 40', 40" , 40"', 40""** light to indicate an injection is in progress. These LCDs are in electrical communication with battery **126** by means of wiring **88**. The reverse mode is used to retrieve unused medicament at the end of each job thereby reducing waste of medicament. The reverse mode must be set, by means of the "function" button **108** and the down arrow **106** prior to the dosage being set. In actual use conditions, a simple LCD, such as made by model MV-1000 made by Gilway has been used and works well however other LCDs having similar features could be used.

In all of the hand-held injection devices **40, 40' , 40" , 40"' & 40"",** optional dye means is simultaneously dabbed from dye applicator pad **172** to mark the animal or fowl injected, the applicator pad **172** interconnected by dye fluid tubing **86** to a dye container, and is applied in response to again manually pushing main trigger **42** inwardly. There is no separate trigger for controlling the dye function.

PUMP

In use, a peristaltic-type pump **100** creates a vacuum within tubing that sucks up the fluid from the medicament container **70** by repetitively compressing and expanding a section of tubing. In actual use conditions, a relatively large bore high density plastic tubing has been used with great success. The size of the tubing bears a direct relationship to the length of time it takes to complete an injection, namely, the larger the tubing, the quicker the injection time. This repetitively compressing and expanding a section of tubing creates a vacuum within the tubing and provides the force to move the fluid from the medicament container through the system to the hand held unit **40, 40', 40", 40"' or 40""** without introducing contamination into the system. In actual use conditions, a peristaltic-type pump such as that made by Barnant Co., 28W 092 Commercial Ave. Barrington, IL 60610, has been used although other peristaltic-type pumps could be used. The peristaltic-type pump **100** may additionally be set so that the serum, or other fluid medicament, may be sucked up automatically from the hand-held injection device **40, 40', 40" , 40"' or 40""** by manually reversing the pump **100**, to prevent waste. The pump **100** is self-priming. The user simply continues to push trigger **42** until serum or other fluid medicament reaches hand-held injection device **40, 40', 40" , 40"' 40""**. A second peristaltic-type pump **100'** may be provided and mounted in a piggy -back manner to force a second fluid medicament through the system at the same rate for delivery through the hand-held injection device **40"**. Pump **100** is driven by motor **104**, **Fig. 7,** in actual use a 12 volt motor, model # 33GN2732-276 GHS, made by Power Electric Products, 2285 Daniels St. Long Lake, MN 515 has been used although other similar 12 volt motors could be used.

Because peristaltic pump **100** works on the premise of displacement, pump **100** accurately and consistently delivers the same dosage. The dose delivered can be formulated by multiplying the

inner cross-sectional area of the tubing inside the pump **100** by the distance the tubing is compressed during one cycle of the peristaltic pump. Each time trigger **42** is manually depressed and safety interlock 152 is pushed to its second position in response to needle **56** being fully inserted, the exact dosage is dispensed by pump **100**. This increases accuracy of delivery of the dosage and eliminates user error caused by fatigue.

Battery **126** powers motor **104**. In actual use conditions, a 12 volt, sealed, lead acid, rechargeable battery, such as model # DG 12-4.2 Guardian made by Douglas Co. has been used although other similar batteries could also be used. One battery charge should be able to power the device 20 through one full day of injections.

CASE

Any of the embodiments of veterinary medicament delivery system **20** can be housed in a resilient, light weight material backpack, or other housing, so long as the housing protects the various elements of the veterinary medicament delivery system **20** from dirt and dust. Having the system stored in a backpack enhances portability and storage of the system **20**.

Draw-off needle is held in place inside medicament container **70**. Tubing **80** is attached at a first end to intake tubing and at a second end to a lead-in tubing for a peristaltic-type pump **100**.

MIXING TUBE

An optional mixing tube **190**, **Fig. 10**, is provided to mix together two medicaments prior to the medicaments being injected. Mixing tube **190** consists of a chamber **192** with double helix-shaped fins **194** that, when two fluids are introduced through a Y-shaped coupling **198**, the two fluids are intermixed as they are pushed down mixing tube before exiting through quick connect fluid coupler **196**. As fluids flow through mixing tube **190**, the fluids, not shown, pass over a series of stationary, helical-shaped fins **194** which causes the fluids to fold over on themselves. In this manner the fluids are completely mixed in a short distance, e.g. three inches.

DYE APPLICATOR

Dye reservoir **60** has an intake tubing affixed to reservoir **60** that draws up dye in response

to a separate dye pump. Dye is drawn into dye tubing **86** in fluid communication with any of the hand-held injection devices **40, 40', 40", 40"' or 40""**, but especially with **40"' & 40""**. Dye intake tubing **86** draws up dye in response to activation of a dye pump in response to activation of the dye pump by the injection circuit. This pump delivers dye to the applicator pad in increments of 0.1 second for each injection. By setting the dye pump at zero, the dye can be discontinued if desired.

Dye applicator pad **172** is mounted on the proximal surface **22** of hand-held injection device **40, 40', 40", 40"', or 40""** adjacent needle **56** and head lamp **46**. Dye applicator pad **172** is in fluid communication with dye reservoir **60**. It has been found that dye is dabbed onto the animal's coat or skin simultaneously with the injection works well. The dye applicator pad dabs the dye in 0.1 second increments, depending on the control unit **110** setting. The dye marks the animal injected so that it is easy to distinguish between animals that have been vaccinated or injected and those that have not. This feature is a switched function and can be turned on or off according to the needs of the job, as set by the function key of control unit **110**.

DOSAGE CONTROL

In all embodiments, the selected dosage is administered cleanly and completely, without dripping because the pump **100** is set to automatically reverse at the end of each injection. The amount of this reverse is set into control unit **110** before the dosage is set. This automatic reverse prevents serum, or other fluid medicament, from flowing out of the end of the hand-held injection device **40, 40', 40", 40"', or 40""** due to latent pressure. A quick reverse after each injection prevents drip. It is important, also, to retrieve unused medicament at the end of each injection session. The pump reverse switch is used to retrieve unused medicament at the end of the injection session. The need for reversing fluid flow does not allow for use of a delivery valve because such a valve would prevent any reverse action.

It is an important feature of this system that it does not include a delivery valve. The absence of a delivery valve necessitates a positive, abrupt stop upon the completion of each injection followed by a quick reverse by which drip can be prevented. The injection process, therefore, involves an automatic abrupt stop upon delivery of each dose, immediately followed by a short pre-set reverse sufficient to prevent any drip. This reverse can differ according to the

viscosity of the medicament and should be set prior to the start of each injection session, usually 8 -10 pulses. By setting this reverse action prior to setting the correct dosage, the precise delivery of each injection is not impaired. The automatic reverse is set using the "Function" keypad **108** and the down arrow **106** on the front of control unit **110**.

Electronic dosage control **130** uses a photo-optic sensor **138**, shown in detail in **Fig. 7** , to control the volume of medicament fluid pumped by pump **100**. Pump **100** drives shaft **134** that turns an encoder disc **132** that has slots that are placed at a calibrated distance from one another around the perimeter of circular encoder disc **132**. As the encoder disc **132** rotates in response to rotation of drive shaft **134**, the slots pass between an emitter and a receiver of the photo-optic sensor **138**. As the encoder disc **132** passes through the sensor **138**, the sensor **138** "counts" the number of slots that pass between an emitter and a receiver inside a dark housing within the control unit **110** adjacent the pump **100**. The combination of the distance between the slots and the number of slots allowed to pass through the sensor **138** determines the amount of medicament that is dispersed. This amount is dependent on the viscosity of the medicament and the temperature of the medicament. Setting the required number of pulses by the photo-optic sensor to accurately administer the necessary precise dose is usually accomplished by taking measure of a set number of pulses, maybe 200, then calculating the required pulses for the desired dose. In actual use conditions, the photo-optic encoder disc **132** has 72 slots although other sized discs with other numbers of slots, could be calibrated for use. Since the sensor **138** responds positively in individual slots, it is possible to set the dosage to within 0.0138 milliliter (ml) accuracy. The pump stops abruptly upon the delivery of each dose, then automatically reverses to the number of pre-set pulses in order to stop drip. Usually 10 pulses are sufficient to clear the needle **56** of any drip. This sensor **138** is wired into a circuit board **140** for dosage selection control, one of the functions of control unit **110** of **Figs. 1, 6, 8 & 9** which allows selection and control of the distance the fluid travels in pump **100**. To change the dose, manipulate a switch of dosage selection control and select the dose from a selectable dosage LCD display **112** by pressing "Function" keypad **108** until "dose" appears. Then, using the "up" and "down" arrow key pads **106**, enter the selected dosage. This number will be flashing on the LCD. To set the dose, touch the "function"keypad **108** at which time the number will stop flashing.

Other features of the control unit **110** "function" keypad **108** are: automatic reverse setting, a re-setable counter and a dye selection, shown in detail at **Fig. 1,6,8 & 9**. Counter records a dispensed dosage every time the hand-held injection device **40** is activated. Counter keeps a running total of the number of injections given while the veterinary medicament delivery system **20** is turned on. The counter is reset manually by pressing the down arrow **106** on control unit **110**. The total is recorded by a liquid crystal display **112** on the control unit **110**. A micro switch liquid crystal display unit, made by Curtis Instruments, Inc., 204 Kisco Ave., Mt. Kisco, NY 10549, has been used and works well although other LCD's could be used.

Up and down arrows **106** are used to select from a range of dose settings LCD display **112**, the appropriate dose, the chosen dosage setting illuminated by a light. Dosage settings are calibrated into the electronic control unit **110** to accommodate the desired dose. Also shown are three switches : power on/off **114**, pump **116** forward/reverse, and head lamp on/off switch **120**.

Veterinary medicament delivery system **20** may be cleaned by flushing with hot, e.g. 160oF, detergent/water mixture placed in medicament container **80**. To accomplish cleaning, the pump switch on the face of the control unit is set to "forward" in order to circulate cleaning/sanitizing solutions for effective "clean in place". Cleaning practices vary among operators. Flushing with hot detergent water, followed by a clean rinse, is accepted by many who fear harming the vaccines with disinfectants. Others flush with hot detergent water and follow with an alcohol rinse, which, of course, is then rinsed.

All the hand-held injection devices **40, 40', 40", 40"'. & 40""** have two signal lights on a top surface thereof, namely red LED **50** signaling low medicament, and green LED **48** indicating injection in progress. On the proximal surface **22** of each hand-held injection device **40, 40', 40", 40"' or 40""** dye applicator pad **172** can be mounted which, when powered on, marks each animal or bird to which medicament is administered.

In the operation of hand-held injection device **40"'**, **Fig. 5**, trigger **42** must be depressed, and the needle **56** must be fully inserted into animal or fowl, which pushes safety interlock **152** the tip of the needle hub **58** to complete the electrical circuit to actuate the pump **100** which accomplishes administration of medicament. This double requirement of trigger **42** being

depressed and safety interlock solid member **152** pushed to a second position before the medicament is administered reduces the dangers of self-injection. And because the trigger **42** is being depressed, either serially or continually, rather than manually pushing a syringe handle in order to pump the medicament into the animal through the needle and against the pressure of a return spring, this system greatly reduces fatigue and the incidence of repetitive motion injury in the operator. Additionally, use of this system **20** permits greater speed of administration of medicament to the multiplicity of animals or fowl sought to be medicated. Hand-held injection device **40""** also having safety interlock **152**, **Fig. 13**, works similarly to hand-held device **40"'**.

In the operation of hand-held injection device **40 , 40',& 40",** trigger **42** must again be depressed for each injection. Emergency stop button **44** enables the user to stop the injection in the case of either piercing the user's skin with the needle **56** or running the needle through the subject animal body , ex. the ear. This deters accidental self-injection and accidental waste of expensive medicament in the case of running the needle through the subject animal body.

Use of the electronic dosage control **130**, permits changing of the dosage to be administered and is especially useful when different dosages are to be administered in succession, however, it would be equally useful in situation where a multiplicity of animals or fowl were administered the same dosage of medicament.

When it is desired that two medicaments are to be administered simultaneously, a mixing tube **190**, **Fig. 11** may be added between the pump**100, 100'** and the hand-held injection device **40** . In addition to mixing tube **190**, an additional pump **100'** and related tubing and T-coupling **198** are used to permit mixing of the two medicaments prior to administration.

Veterinary medicament delivery system **20** may be cleaned by flushing with hot, e.g. 160°F, detergent/water mixture placed in medicament container **80**. Cleaning practices vary among operators. Flushing with hot detergent water, followed by a clean rinse, is accepted by many who fear harming the vaccines with disinfectants. Others flush with hot detergent water and follow with an alcohol rinse, which, of course, is then rinsed.

These important features allow for very precise dose from a self-priming, electrically powered pump through a valve-free system which can prevent drip, include important safety features to deter self-injection, automatically mark each animal, total the numbers of injections,

retrieve unused medicament and provide for an easy method of internally 'cleaning-in-place' of the system.

Although the present invention has been described in considerable detail with reference to certain preferred versions thereof, other versions are possible. Therefore, the spirit and scope of the appended claims should not be limited to the description of the preferred versions contained herein.